The ERM Group

CRITIQUE OF ICF-CLEMENT'S
RISK ASSESSMENT OF THE TYSON'S SITE

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TABLE OF CONTENTS


| | | Page |
|---|---|---|
| Section 1 - Introduction | | 1-1 |
| 1.1 | Background | 1-1 |
| 1.2 | Summary of Key Findings | 1-2 |
| Section 1 - Objectives of the RA | | 2-1 |
| 2.1 | ICF-Clement's Stated Objectives of the RA | 2-1 |
| 2.2 | ERM's Position on ICF-Clement's Objectives | 2-1 |
| Section 3 - Critique of Modeling | | 3-1 |
| 3.1 | Introduction | 3-1 |
| 3.2 | The Conceptual Model - Define Geometry and Characteristics of the Geologic System | 3-2 |
| 3.3 | Quantify Hydrogeologic Parameters of System Components | 3-2 |
| 3.4 | Determine Fundamental Processes Affecting Transport | 3-5 |
| 3.5 | Define Boundary Conditions | 3-6 |
| 3.6 | Model Application | 3-6 |
| 3.7 | Calibration and Verification | 3-12 |
| Section 4 - Critique of the Remainder of the RA | | 4-1 |
| 4.1 | Introduction | 4-1 |
| 4.2 | Source of Contamination | 4-1 |
| 4.3 | Selection of Indicator Chemicals | 4-2 |
| 4.4 | Toxicological Evaluation | 4-5 |
| 4.5 | Identification of Exposure Points | 4-7 |
| 4.6 | Transport of Contaminants | 4-10 |
| 4.7 | Uncertainties Involved in the RA (Section 9) | 4-12 |
| 4.8 | "Determination of Soil Removal Action Levels" (Section 8) | 4-14 |

# SECTION ONE

# INTRODUCTION

## 1.1 Background

This report prepared by Environmental Resources Management, Inc. (ERM) critiques the ICF-Clement Associates' Risk Assessment (RA) of the Tyson's Dump Site which has been used by EPA as a basis for much of the Focused Feasibility Study (FFS) of the same site. A separate document evaluates the FFS.

The ICF-Clement RA is presented in 10 sections including as follows:

Section
- 1 - Introduction
- 2 - Selection of Indicator Chemicals
- 3 - Nature and Extent of Contamination by Indicator Parameters
- 4 - Identification of Exposure Pathways
- 5 - Fate and Transport Modeling
- 6 - Exposure Point Concentrations
- 7 - Risk Assessment
- 8 - Determination of Soil Removal Action Levels
- 9 - Uncertainties Included in the Risk Assessment
- 10 - Conclusions and Recommendations for Future Work.

Section 2 of this critique responds to the objectives of the RA.

Fate and transport modeling (Section 5 of the RA) is the most important part of a Risk Assessment. For this reason, ERM has focused its comments on the fate and transport modeling, and presents an in-depth critique of the ICF-Clement approach in Section 3 of this report. Comments on the remaining sections of the Tyson's RA are presented in Section 4.



AR312081

### 1.2 Summary of Key Findings

ERM has identified the following general areas where the RA is flawed and has led to inappropriate conclusions regarding the Tyson's Site:

- first and foremost the modeling methodology used cannot be considered as a sound basis for decision making, because each of the fundamental steps required in modeling were either ignored or incorrectly performed.

- Additionally:

  - the RA objectives are inappropriate
  - the wrong compounds are selected as indicators
  - the major source of contamination, DNAPL in bedrock, has not been considered
  - too little data have been taken to determine current concentrations at exposure points
  - the toxicological interpretations in the RA are not scientifically defensible

# SECTION TWO

# OBJECTIVES OF THE RA

## 2.1 ICF-Clement's Stated Objectives of the RA

The stated objective of the RA is as follows:

> "To assess the environmental health risks associated with exposure to chemical contamination at Tyson's Dump. The assessment will estimate the risks associated with potential exposure resulting from the current situation and from future conditions if a no-action alternative were adopted. In addition, the information gathered during the assessment will be used to determine health-based action levels for soil removal. Since USEPA, in its record of decision, has recommended excavation and off-site disposal of contaminated soils, these action levels will help to specify the location and extent of the excavation."

## 2.2 ERM's Position on ICF-Clement's Objectives

ERM contends that the RA is incomplete and biased because of flawed objectives. The RA should have additionally considered 1) the risks posed by excavation, and 2) the effectiveness of alternatives to excavation. The alternatives analysis previously relied upon in the 1984 ROD was cursory and qualitative, and is not consistent with the level of detail being presently provided in the RA.



AR312083

SECTION THREE

CRITIQUE OF MODELING

## 3.1 Introduction

Chapter 5 of the RA states its purpose as follows: "to define the environmental and modeling parameters required for the calculations used in assessing the risk in Chapter 7 and in determining action levels in Chapter 8". It is important to note that the required model is not simply a first cut or rough outline which might produce some general results. On the basis of pollutant concentrations described by the model, decisions are made to spend tremendous resources to protect public health. Without appropriate modeling, expensive remedial actions will be designed which offer no increased protection to the public.

ICF-Clement has failed to adequately perform the fundamental steps considered necessary in producing a model which might be used to determine future risks. They fail to correctly define the hydrogeologic system i.e., boundary conditions . The hydrogeologic system provides the context in which the model is used. ICF-Clement goes on to provide only rough estimates for the values of hydrogeological parameters. They neglect fundamental physical processes of contaminant transport. ICF-Clement does not acknowledge the present most probable source of contamination. They select models that are not designed to produce the resolution required to accurately determine risks from present or future conditions. The selected models are then improperly applied, producing large errors and leading to false conclusions. Finally, ICF-Clement makes no attempt to calibrate various parts of the model with field data. The model depends heavily on concentrations assumed to be found in the soil water but no soil water samples were taken. In many sections of the modeling effort ICF-Clement acknowledges the lack of field data. In these sections the RA does express the need for further study. It is ERM's position that there were far too many unknowns at the Tyson site when this effort was conducted, therefore making this effort invalid.

There are several fundamental steps which must be followed to implement a model that can be used to determine future risks and action levels. Comments on the model used in the RA are organized under the headings of these steps.

## 3.2 The Conceptual Model - Define Geometry and Characteristics of the Geologic System

ICF-Clement failed to properly interpret the geometry and characteristics of the geologic system. Figure 3-1A is a geologic cross section from the ICF-Clement RA; Figure 3-1B is the same figure drawn to show actual field conditions based on ERM's field investigation. The fundamental difference between the two cross sections is that ERM's cross section (based on between actual field conditions) shows the interruption of continuity the unconsolidated material in the lagoon area and the off-site overburden by a bedrock outcrop extending between the former lagoons and the railroad tracks. Failure to understand the geologic conditions is a serious flaw in the definition of contamination migration pathways. Potential contamination of river water will not result only via ground water flow through the lagoons and the unconsolidated material to the river. The bedrock system is obviously an integral part of the migration pathway which was omitted in the modeling by ICF-Clement. (Refer to Section 3 of ERM's response to the FFS for a more detailed discussion of the relationship between the shallow and deep aquifer and the probable effect on contaminant migration).

## 3.3 Quantify Hydrogeologic Parameters of System Components

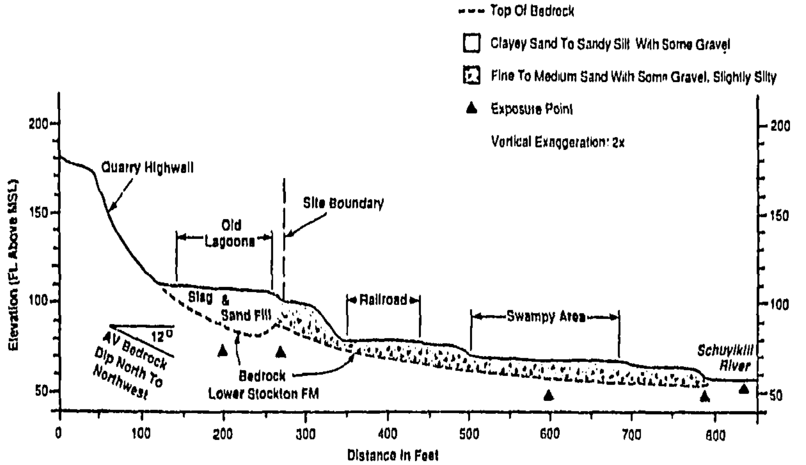
Quantification of the parameters required for input to the selected flow or transport model(s) is an important step in the modeling process which was poorly done by ICF-Clement. Calibration or"fine-tuning" of these parameters by matching model output with field observations is necessary if the accuracy of the model is to be confirmed. The discussion below ignores the fact that ICF-Clement, EPA, and EPA subcontractors have improperly identified the site geologic conditions (see 3.1 above) and looks at the modeling effort on its own merits.

Several hydrogeologic parameters are required as inputs to the models used.

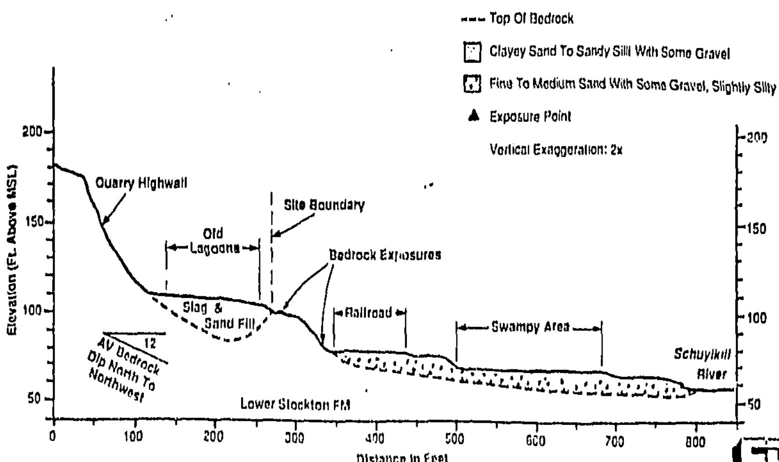
1. The depth of the aquifer hydraulically connected to the lagoon area.

   The RA states "Based on the Remedial Investigation/Feasibility Study the aquifer thickness is about two feet". It is not clear exactly how the thickness of two feet for the water table aquifer is determined. In fact, no mention is made of this aquifer under discussions of ground water (p.11) in the RI/FS. The site as represented in cross sections

# Figure 3-1A
## Generalized Geologic Cross Section As Presented and Used By EPA in the FFS




# Figure 3-1B
## Generalized Geologic Cross Section As Modified By ERM, Based Upon Actual Field Data, To Show True Site Hydrogeologic Conditions



(Figures IV-1 and IV-2 in the RI/FS) shows considerable horizontal spatial variability. In one cross section the western lagoon area is not connected by any saturated flow path to the shallow water table aquifer. Apparently the estimate of aquifer thickness is meant to be a very rough approximation.

2. The Darcy velocity of ground water in the aquifer.

   The Darcy velocity in the aquifer is also presented as a rough approximation, this is apparent in the following quote from the RA, "The remedial investigation gives the horizontal Darcy velocity as 0.17 feet/day from the site to the river. Based on field observations of the gradient off site, the velocity on site is probably double this number, i.e., 0.34 feet per day."

3. Discharge from ground water into the river.

   Determination of ground water discharge into the river can only be characterized as a preliminary approximation. The Risk Assessment states: "Assuming, based on the RI/FS, that 10% of the flow off site is intercepted by the leachate collection system, the daily ground water discharge into the river is 162,000 gallons/day or 0.25 cfs. Some of this flow may be from the deeper, bedrock aquifer." Data supporting the assumption that 10% of the flow off-site is intercepted by the leachate collection system could not be found in the RI.

These estimates of hydrogeologic parameters may be useful for making initial estimates of contaminant transport. However, they are not representative of the detailed knowledge required to make accurate predictions.

Hydraulic communication between the shallow or "surficial aquifer" and the bedrock aquifer is a fundamental hydrologic condition which was not represented in the models used by ICF-Clement. This was due to "lack of data" on the bedrock aquifer. From p. 5-4 para. 1: "Further investigation is required to refine the preliminary water balance presented above. This should include a field study to investigate whether there is a hydraulic connection between the water table and bedrock aquifers."

### 3.4 Determine Fundamental Processes Affecting Transport

ICF-Clement did not properly identify the processes affecting the transport of contaminants at the site. There are many physical processes which may affect the transport of contaminants through an unsaturated-saturated zone system. The approach that ICF-Clement uses implies that no degradation occurs and all transport is in an aqueous phase in equilibrium with the contaminants adsorbed onto soil.

The presence of Dense Non Aqueous Phase Liquids (DNAPL's) at the site (found during ERM's deep aquifer study) illustrates clearly that transport of contaminants has not occurred only in an aqueous phase as ICF-Clement assumes. Transport of DNAPL is fundamentally different from aqueous phase transport. ERM considers the transport of DNAPL to be the most important factor in determining appropriate remedial actions at the Tyson's site. The DNAPL which has infiltrated into the bedrock at the site is the major source of contamination. Because ICF-Clement was not aware of the presence of the DNAPL it arrived at the erroneous conclusion that the major source of contamination is the soils in the lagoon area.

Advection is the most important process in determining the movement of aqueous phase contaminants in ground water. The ground water velocity and direction must be determined to describe advection. However, these factors of ground water flow are not described in any detail in the RA. The major portion of advection of contaminants occurs through bedrock fractures at the site. ICF-Clement acknowledges that this may be important, however it is not considered due to "lack of data".

ICF-Clement considers degradation of one compound, 1,2,3-trichloropropane in the unsaturated zone. The reason for considering only one substance is given as "scheduling constraints on this project" (pg. 5-6 of the RA). This once again shows the incompleteness of the RA.

A superficial discussion of chemical persistence of contaminants in ground water is given in the RA. A "detailed analysis of the overall residence time of compounds at this site is beyond the scope of this project" (pg. 5-17). Biodegradation is not considered and hydrolysis is only considered at pH=7. This is a totally incomplete analysis of potentially important processes.

The RA does not consider contaminants adsorbed to suspended sediment or bottom sediments in the river. No explanation or justification of this deletion is given. It is interesting to note that the model employed in the RA includes adsorption to sediments. Apparently, ICF-Clement modified the model to exclude this process.

The treatment and analysis in the RA of the basic processes that affect transport of contaminants can at the very best be described as a preliminary, "back of an envelope" first approximations. This is totally inappropriate when considering the proposed dollars to be spent for remediation.

## 3.5 Define Boundary Conditions

ICF-Clement failed to properly define the site boundary conditions. To use any model successfully, boundary conditions must be defined. These include the hydrologic and contaminant sources and sinks. Due to previously described errors and "lack of data" (Sections 3.1 to 3.3 above), ICF-Clement did not recognize DNAPL in the bedrock aquifer as the primary source of contamination. This is a very significant oversight to the extent that the modeling effort is fatally flawed.

The RA states on page 5-4: "Further investigation is required to refine the preliminary water balance." ERM considers the water balance a crucial step in the modeling procedure. Net infiltration, obtained from the water balance defines the initial flux of contaminants into ground water in the model used in the RA. Although the RA states the need for further investigation to define this parameter, a very rough estimate is used.

## 3.6 Model Application

### 3.6.1. Incorrect Application of Unsaturated Zone Model

ICF-Clement uses Enfield's model of unsaturated zone transport to describe contaminant concentrations entering the water table aquifer as a function of time. The following discussion shows that ICF-Clement obviously did not understand the model they were using. This misunderstanding led to erroneously deciding that degradation in the unsaturated zone is unimportant.

The following equation is the solution to Enfield's model as given in the RA (equation 5-1, page 5-7 of the RA).

$$C_t/C_o = \exp\left(-\frac{\varrho t \sum k_i}{\theta R}\right) \qquad (3\text{-}1)$$

where:

$C_t$ = concentration remaining after time t

$C_o$ = initial concentration of contaminant
$\rho$ = soil bulk density
$\theta$ = soil volumetric water content
R = retardation factor
t = time
$k_i$ = sum of the first-order degradation processes

Enfield's model (equation 3-1 above) describes concentrations of contaminants in the soil water as a function of time assuming: instantaneous and linear absorption/desorption; first-order degradation; and initial concentration of contaminant, $C_o$, in the soil water.

ICF-Clement apparently did not understand that $C_o$ and $C_t$ are concentrations in the soil water. In fact, at t = the time required to transport contaminant through the unsaturated zone, $C_t$ defines the concentration of contaminant entering the ground water. This misunderstanding lead ICF-Clement to equation 3-2;

$$C_p = C_o \left[1 - \exp\left(-\frac{\rho t}{\theta R} \Sigma k_i\right)\right] \quad (3\text{-}2)$$

where;

$C_p$ = concentration infiltrating into the aquifer

Since $C_t$ is defined as the concentration infiltrating to the aquifer in equation 3-1 it is clear equation 3-2 is completely false. ICF-Clement uses equation 3-2 to show that degradation is unimportant in the unsaturated zone. Since equation 3-2 is false there is no basis to this argument.

The model of the unsaturated zone at which ICF-Clement arrives assumes: linear adsorption/desorption; no degradation; and complete mixing. This model may be appropriate for laboratory studies carried out under very high moisture content. However, at the Tyson's site, contaminants are not evenly dispersed at any scale and many are dissolved in hydrophobic liquids. Thus, contact between infiltrating water and potential ground water pollutants is limited. In addition the presence of DNAPL in the unsaturated zone dominates and complicates the transport processes. Without careful consideration of these effects no model could be accurate.

3.6.2 Incorrect Application of the VHS Transport Model

The following discussion addresses an obvious misunderstanding by ICF-Clement of the fundamental assumptions of the VHS model. This lack of understanding resulted in incorrect data being input to the model, an artificial increase in the contaminant mass loading rate to the aquifer.

On pages 5-11 & 12, ICF-Clement describes the VHS model. The VHS model is given as:

$$\frac{C}{C_o} = \mathrm{erf}\left(\frac{Z}{2(DY)^{1/2}}\right) \mathrm{erf}\left(\frac{X}{4(DY)^{1/2}}\right) \qquad (3\text{-}3)$$

where

D = dispersivity = 0.10 Y (Pickens and Grisak 1981)

= 2.4 m (site boundary)

= 12.2 m (swampy area)

= 18.3 m (river)

Y = distance from source to exposure points

= 24 m (site boundary)

= 122 m (swampy area)

= 183 m (river)

X = site width = 183 m (600 feet)

Z = $Y\ (V_e/V_{gw})$

$V_{gw}$ = ground water (seepage) velocity - 2 inches/day = 0.051 m/day (Baker 1985a) *

$V_e$ = leachate penetration velocity

$= \dfrac{\text{infiltration rate}}{\text{porosity}}$

$= \dfrac{(15\ \text{inches/year})\ (1/365)\ (0.0245\ \text{m/inch})}{0.35} = 3\text{x}10^{-3}\ \text{m/day}$

Z = 1.4 m (site boundary)

= 7.2 m (swampy area)

= 10.8 m (river)

* $V_{gw}$ is described in the RA as the Darcy velocity. This is incorrect. Based on discussion of the "average ground water velocity" in the draft RI it is clear that $V_{gw}$ = 2 inches per day is the seepage velocity. The Darcy velocity would be approximately 0.35 x $V_{gw}$.

The equations as given are taken from EPA documentation of the VHS model (EPA 1985). ICF-Clement has incorrectly applied these equations as a result of not understanding the assumptions on which the VHS model is based, specifically, by incorrectly calculating a Z value from EPA's equation:

$$Z = Y\ (V_e/V_{gw}) \qquad (3\text{-}4)$$

where

Y = horizontal depth (width) of the contaminant source area

Z is the vertical thickness (penetration depth) of the contaminant plume at the starting point of the VHS model. Y in equation 3-4 above is a constant and is not the same as Y in the VHS model, equation 3-3. "Y [in equation 3-4] is the depth of the facility" (EPA 1985). That is, a horizontal width of the lagoons parallel to the direction of ground water flow. From the dimensions of the lagoons, 92 x 290 feet (page 5-10 of the RA), Y for equation 3-4 should be 92 feet. In the VHS model, equation 3-3, Y is a horizontal distance from the downgradient edge of the contaminant source at which the VHS model will calculate a concentration ratio, C/Co.

The correct value of Z, using the EPA equation 3-4 would be:

$$Z = Y\ V_e/V_{gw} = 92 \times \frac{\dfrac{15\ (\text{inches/year}) \times (1/365)(0.0254\ \text{m/inch})}{0.35}}{0.17\ (\text{ft/day}) \times (0.305\ \text{m/ft})}$$

= 5.3 feet

= 1.6 meters

This is a constant value in the VHS model.

The EPA equation, $Z = Y\ (V_e/V_{gw})$ is a heuristic equation defined because a Z value for the contaminant source is generally not known. The thickness of the contaminated aquifer has been defined as two feet (p. 5-10 of the RA). The entire two feet is uniformly contaminated as a result of the dilution calculation (p. 5-11 of the RA) used to determine the concentration, $C_a$,



AR312092

which would leave the site, i.e., enter the VHS model. Thus, Z = 2 feet, would be an reasonable choice for input to the VHS model consistent with the data presented in the RA.

Increased contaminant mass loading into the VHS model results from the incorrect calculation of Z. The contaminant mass loading into the VHS model can be calculated from:

$$P\left[\frac{\text{mass}}{\text{time}}\right] = Q_{gw}\left[\frac{\text{volume}}{\text{time}}\right] \times C_a\left[\frac{\text{mass}}{\text{volume}}\right] \qquad (3\text{-}5)$$

where

$Q_{gw}$: Volume of contaminated water entering the VHS model per unit of time

$C_a$ : Concentration of contaminated water at entering the VHS model

P : Contaminant mass entering the VHS model per unit of time

and $Q_{gw} = X \times Z \times V_{darcy}$

X & Z are from equation 3-3; X = 600 ft (183 meters)

$V_{darcy} = V_{seepage} \times \text{porosity}$

$$= 0.17 \frac{\text{ft}}{\text{day}} \times 0.35$$

$$= 0.06 \frac{\text{ft}}{\text{day}} \quad (0.018 \text{ m/day})$$

Note: the variables $Q_{gw}$, $C_a$ and P are constants in the VHS model.

To calculate the mass loading rate to the VHS model a Z value must be defined. For comparison, three Z values will be considered:

Z = 2 ft : the defined aquifer thickness beneath the lagoons



AR312093

$Z = 1.4$ m: contaminant penetration depth at the "site boundary" used in the RA

$Z = 1.6$ m: contaminant penetration depth calculated by ERM using equation 3-4

The contaminant mass loading rate, P, is calculated for the three Z values above and compared with P for Z = 10.8 meters, the depth used in the RA to calculate concentration at the river bank, $C_{rb}$.

for Z = 2 feet (0.61 meters)

$$\frac{P\ (Z = 10.8\ m)}{P\ (Z = 0.61\ m)} = \frac{(183)(10.8)(0.018)(0.35)\ C_a}{(183)(0.61)(0.018)(0.35)\ C_a}$$

$$= 17.1 \text{ times increase in mass loading}$$

for Z = 1.4 meters

$$\frac{P\ (Z = 10.8\ m)}{P\ (Z = 1.4\ m)} = 7.7 \text{ times increase in mass loading}$$

for Z = 5.3 meters

$$\frac{P\ (Z = 10.8\ m)}{P\ (Z = 1.6\ m)} = 6.8 \text{ times increase in mass loading}$$

Using the Z values defined above and recalculating $C_{rb}$, the concentration in the aquifer at the river bank, will result in $C_{rb}$ values lower than those calculated in the RA.

### 3.6.3 Volume Flow into the Ground Water System vs Discharge to the Schuylkill River

It is the intent of this discussion to demonstrate an inconsistency in the volumetric water balance. The basis of any ground water flow modeling is conservation of mass; the water volume flowing into a system must equal the volume leaving the system. The infiltration recharge to the system, $Q_{in}$, is compared with volume discharged, $Q_d$; $Q_d$ should equal $Q_{in}$.

A range of $Q_{in}$, calculated infiltration recharge, is given on page 5-3 of the RA: 4300 to 12,000 gpd.

The discharge to the river, $Q_d$, is defined on page 5-13 of the RA:

"$Q_d$ = volumetric flow rate of discharge into the river assuming, based on the remedial investigation/FS that 10% of the flow off site is intercepted by the leachate collection system, the daily groundwater discharge into the river is 162,000 gallons/day or 0.25 cfs. Some of this flow may be from the deeper, bedrock aquifer."

The water volume leaving the ground water system is 162,000 gpd plus 16,200 gpd collected by the leachate collection system, $Q_d$ = 178,200 gpd. Comparing $Q_d$ to $Q_{in}$:

$$\frac{Q_d}{Q_{in}} = \frac{178,200}{4,300} = 41$$

or

$$= \frac{178,200}{12,000} = 15$$

Thus, using data from the RA it appears that the volume of water leaving the ground water system is 15 to 41 times larger than the volume entering. This water imbalance is a fundamental flaw in the modeling resulting in part from poor conceptual model development.

### 3.7 Calibration and Verification

The standard procedure for the use of contaminant transport models is to calibrate and verify the models wherever possible. This process is not considered in the RA. Without a calibration procedure, any model may produce erroneous results.

Calibration is necessary to adjust input parameters until the model produces results which match the aquifer conditions. For example, the model of the unsaturated zone which is ultimately used in the RA defines a concentration of contaminant in the soil water as a function of the concentration found in the soil. This may be checked by extracting soil water and testing for the contaminant. The model could then be adjusted to produce more accurate estimates of soil water concentrations. In contrast, no samples of soil water were collected. Without extensive and objective calibration even the most carefully constructed model can produce erroneous results.

# SECTION FOUR

## CRITIQUE OF THE REMAINDER OF THE RA

### 4.1 Introduction

In this section, ERM critiques the remainder of the RA. Emphasis is given to major points of contention which would significantly affect EPA's decision-making process.

In summary, ERM has found many problems throughout the assessment process used by ICF-Clement. In particular, the RA is inadequate in the following major areas.

- the source of contamination has not been adequately defined
- the wrong indicator chemicals have been selected
- the toxicological evaluation is incomplete and biased
- exposure points have been inadequately identified and exposures have been miscalculated
- the primary transport pathway has been ignored
- uncertainties in the process are not adequately addressed

The result of these combined errors is an inaccurate calculation of action levels for excavation of soil. Each of the major inadequacies are discussed in some detail in the following sections.

### 4.2 Source of Contamination

ICF-Clement did not properly define the source of contamination. The importance of identifying the correct source of contamination cannot be stressed enough. The RA recognizes the following sources of contamination:

> "... the primary source of contamination remaining at the Tyson's Dump site are subsurface soils. Although liquid wastes were reportedly drained from the lagoons and the lagoon areas were backfilled and hydroseeded during closure of the site in the early 1970s, the contaminated soils at the bottom and sides of the unlined lagoons were not removed. Ground water at the site that has become contaminated, by movement through the lagoon areas or by percolation of

contaminants from the unsaturated zone, constitutes an additional source of contamination."

In evaluating these sources of contamination, all relevant existing information should be considered. The R.I. Report (Draft) dated August 1984 stated:

"The pathway of least resistance for site contaminant migration, as shown on the two geologic cross-sections, probably is through the sand and gravel overlying bedrock. However, contaminants also may migrate within the upper bedrock since the old lagoons appear to have been situated within the rock quarry areas where the rock is known to be highly jointed and fractured. This situation should permit rapid infiltration of contaminants into the underlying bedrock. However, comparative data from the nested shallow and deep well ERT-1 indicates that a slight artesian condition may exist in local bedrock such that deep migration of contaminants may not occur."

The referenced geologic cross-sections are given here in Figures 3-1a and 3-1b. The cross-sections clearly show the lagoon area situated directly on bedrock. Although a slight artesian condition existed during R.I. sampling, the process of concern should have been the movement of non-aqueous phase liquids (NAPL's)into the underlying fractured bedrock. Since the R.I. had clearly stated the possibility of direct contaminant movement into bedrock; the RA should have fully evaluated this concern and therefore considered contaminants which had migrated into bedrock as a potential source of contamination. Given the presence of DNAPL in bedrock (as identified during ERM's ongoing study of the deep or bedrock aquifer), both the exposure points used by ICF-Clement (located in the surficial aquifer) and the overall assessment of contaminant migration from the site to the river are inappropriate. A complete discussion of the relationship between the shallow or so called "surficial aquifer" and the deep or bedrock aquifer is given in Section 3 of ERM's response to the FFS. A discussion of the behavior of DNAPL's and its importance to the Tyson Site is given in the S. Feenstra and J. Cherry report.

## 4.3 Selection of Indicator Chemicals

ICF-Clement identified the wrong indicator chemicals for the site. The selection of indicator chemicals for a site is based upon an EPA procedure detailed in the Draft Superfund Public Health Evaluation Manual (ICF-Clement, 1985). A series of steps is used to reduce the number of compounds at a site to a manageable



AR312097

number which may then be modeled. The selection process is based primarily upon a chemical's concentration in the various media and toxicologic information. Through the use of worksheets, indicator scores for the chemicals are calculated based upon the aforementioned factors. Final selection of indicator chemicals for a site is based upon the indicator score plus six other important factors. These include water solubility, vapor pressure, Henry's law constants, organic carbon partition coefficient, persistence in the various media, and qualitative weight-of-evidence rating. This procedure selects a minimal number of chemicals which define the site's environment and allows a more thorough modeling effort to be conducted.

ICF-Clement deviated from the draft procedure in two areas: 1) all relevant environmental media were not considered in the evaluation and 2) indicator chemical selection was not based upon the aforementioned factors. The worksheets essential to indicator chemical selection are not provided in the RA and therefore, comments are restricted to the text and Table 2-1 (page 2-2 of the RA). From the more than 100 chemicals detected and identified during the On-Site RI, ICF-Clement selected nine compounds to adequately assess the site.

### 4.3.1 Relevant Environmental Media

ICF-Clement states on page 2-1, line 8 of the RA: "First, the chemicals present at the Tyson's Dump Site were identified and the maximum and average concentrations of each contaminant in the relevant environmental media (surface water and ground water) were calculated (Table 2-1)."

ICF-Clement completely ignored the concentration of contaminants present in the on-site soils and the bedrock aquifer during the selection of indicator chemicals. It is peculiar that ICF-Clement ignored the on-site soils since the EPA's selected action is the excavation of these soils. If these soils are indeed the source of contamination to the river (ERM has shown that this is not true) then they should have been included in the assessment. As discussed previously and as presented in Section 3 of ERM's response to the FFS the true source of contamination to the river is the DNAPL in the bedrock aquifer, which was totally ignored by ICF-Clement and EPA thus making the entire RA meaningless.

### 4.3.2 Tyson's On-Site Indicator Chemicals

ICF-Clement states on page 2-4, lines 3-6 of the RA: "Benzene and xylene were present in high concentrations in the ground water. Since toluene and ethylbenzene behave similarly, benzene and xylene were chosen to represent all other aromatic hydrocarbons."

Examination of the data presented in the RI report shows the top ten compounds detected in ground water in decreasing concentrations (averages in mg/l) to be 1,2,3-trichloropropane (13.5), 4-methyl-2-pentanone (7.2), tetrachloroethylene (3.21), toluene (2.85), o-xylene (1.09), benzene (0.71), ethylbenzene (0.64), trans-1,3-dichloropropene (0.29), and trans-1,2-dichloroethylene (0.15). 1,2,3-Trichloropropane is the only compound detected in significant quantities in the surface water on-site. Clearly, for the aromatic hydrocarbons, toluene and o-xylene are present in the greatest concentrations in the ground water.

The RI report page C-8, 2nd paragraph, lines 9-13, states "Seep areas (EPA Sample Nos. 830126-06 and -07) were the most highly contaminated surface waters sampled, with maximum values reaching 1000 mg/l. The primary compounds found in the seeps were xylenes, 1,2,3-trichloropropane, chlorobenzene, ethylbenzene, toluene, trichloroethylene and tetrachloroethylene." Paragraph 3, line 1 on page C-8 of the RI states "Of the compounds found in surface waters, the most widespread were the xylenes and 1,2,3-trichloropropane." Page C-11, 3rd paragraph, line 4-9 of the same report states "Ground water from Well ERT-1 contained higher concentrations of 1,2,3-trichloropropane (10-100 mg/l) than of other volatile compounds including benzene, carbon tetrachloride, chloroform, and 1,2-dichloroethane. Other compounds in ground water from this well included xylenes, hexanal, 1,2-dichlorobenzene, phthalates, and hexahydro-2H-azepin-2-one (caprolactam)."

Benzene is rarely mentioned among the major contaminants in ground water but is still considered by ICF-Clement to be an indicator chemical. Calculation of indicator chemicals based upon all environmental media (including surface and subsurface soils and sediments) rank toluene, ethylbenzene, and xylene higher than benzene.

Using the aforementioned procedure for indicator chemical selection (draft Superfund Public Health Manual), ERM has re-evaluated the chemicals detected during the On-Site RI and selected indicator chemicals based upon all relevant environmental data. The following lists the indicator chemicals selected by ICF-Clement and ERM. (ERM's list is ranked from highest indicator to lowest).

| ICF-Clement | ERM |
|---|---|
| Benzene | 1,2,3-Trichloropropane |
| Di-n-butyl phthalate | Trans-1,3-dichloropropane |
| 1,2-Dichlorobenzene | Toluene |
| 4-Methylphenol | Arsenic |
| Tetrachloroethylene | 1,2,4-Trichlorobenzene |
| 1,2,4-Trichlorobenzene | Tetrachloroethylene |
| Trichloroethylene | Trichloroethylene |
| 1,2,3-Trichloropropane | Chlorobenzene |
| o-Xylene | Benzene |
| | Cresol |
| | Bis(2-ethylhexyl)phthalate |
| | 1,2-Dichlorobenzene |
| | Trans-1,2-dichloroethylene |
| | Ethylbenzene |
| | 1,1-Dichloroethane |
| | Xylene |
| | Hexachlorobenzene |
| | Di-n-butyl phthalate |
| | Phenol |
| | Chloroform |

ERM's list of initial indicators would then be further evaluated to select a smaller set of final indicators which would be used in fate and transport modeling.

## 4.4 Toxicological Evaluation

The RA does not adequately document toxicological effects. There are major concerns over the misapplication of toxicological data as well as inadequate documentation of toxicological effects.

In particular ERM objects to the cavalier manner in which scientific information is being used to classify 1,2,3-trichloropropane as a carcinogen. ICF-Clement has relied upon short-term testing and structure activity relationship (SAR) analogies to classify this compound as a possible carcinogen. In regards to the use of structure activity relationships, Dr. John Moore, EPA's Assistant Administrator for Pesticides and Toxic substances stated in June 1984 that:

> "SAR is not capable of 'proving' anything. It is useful to the regulator in suggesting substances which could pose a particular danger of toxicity to humans or the environment. However, in my view, we are a long way from a time when SAR will be so highly refined that we will be able to dispense

with experimentation altogether. The chances of error - both false positive and false negative - are simply too great."

The toxicology section for the indicator chemicals is severely deficient in referenced animal and human studies to support the statements made in the RA. The Tyson's On-Site RA document appears to be a combination of risk and endangerment assessments. "A risk assessment is defined as a qualitative/quantitative process conducted to characterize the nature and magnitude of potential risks to public health from exposure to hazardous substances, pollutants, or contaminants released from specific Superfund sites." (Superfund Public Health Evaluation Manual, December 18, 1985 Draft by ICF Incorporated). The toxicology procedure for a risk assessment is detailed in the Toxicology Handbook: Principals Related to Hazardous Waste Site Investigations (US EPA-OWPE,August 1985). Contained in Chapters 9, 10, and 11 of this handbook are examples of toxicological reports for dioxins and furans, trichloroethylene and lead, respectively. Each chapter contains detailed sections of 1) Chemical Properties and Environmental Stability; 2) Summary of Health Effects Data; 3) Noncarcinogenic Studies - Animals and Humans; 4) Mutagenic and Carcinogenic Studies - Animals and Humans; 5) Quantitative Indices of Toxicity - Noncarcinogenic and Carcinogenic Effects; 6) Special Concerns; and 7) References plus appropriate tables summarizing data from animal studies.

"An endangerment assessment evaluates the collective demographic, geographic, physical, chemical and biological factors at a site to determine whether there is significant risk to public health or welfare or the environment as a result of a threatened or actual release of a hazardous substance or waste." (The Endangerment Assessment Handbook, USEPA, August 1985 Draft). Appendix 2 of this handbook has examples of endangerment assessment reports for three levels of site contamination. Level 1 is a "qualitative" assessment; level 2, a "semi-quantitative" assessment and level 3, a "detailed quantitative" assessment. From these descriptions, Tyson's On-Site RI is a level three hazardous waste site and should contain a toxicology section for each indicator chemical as specific as the level 3 example (Appendix 2 - Level 3 assessment - pages 4-1 to 4-16).

Whether this on-site report is a risk or endangerment assessment or a combination of the two, the toxicology section for the indicator chemicals does not follow either of the aforementioned handbooks in style or level of detail. The toxicology text for the indicator chemicals (page 7-2 (last paragraph) to page 7-3) gives only potency factors and carcinogenic classification with